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USGS Science on Coal-Tar-Based Sealcoat and Environmental and Human Health

Presented by
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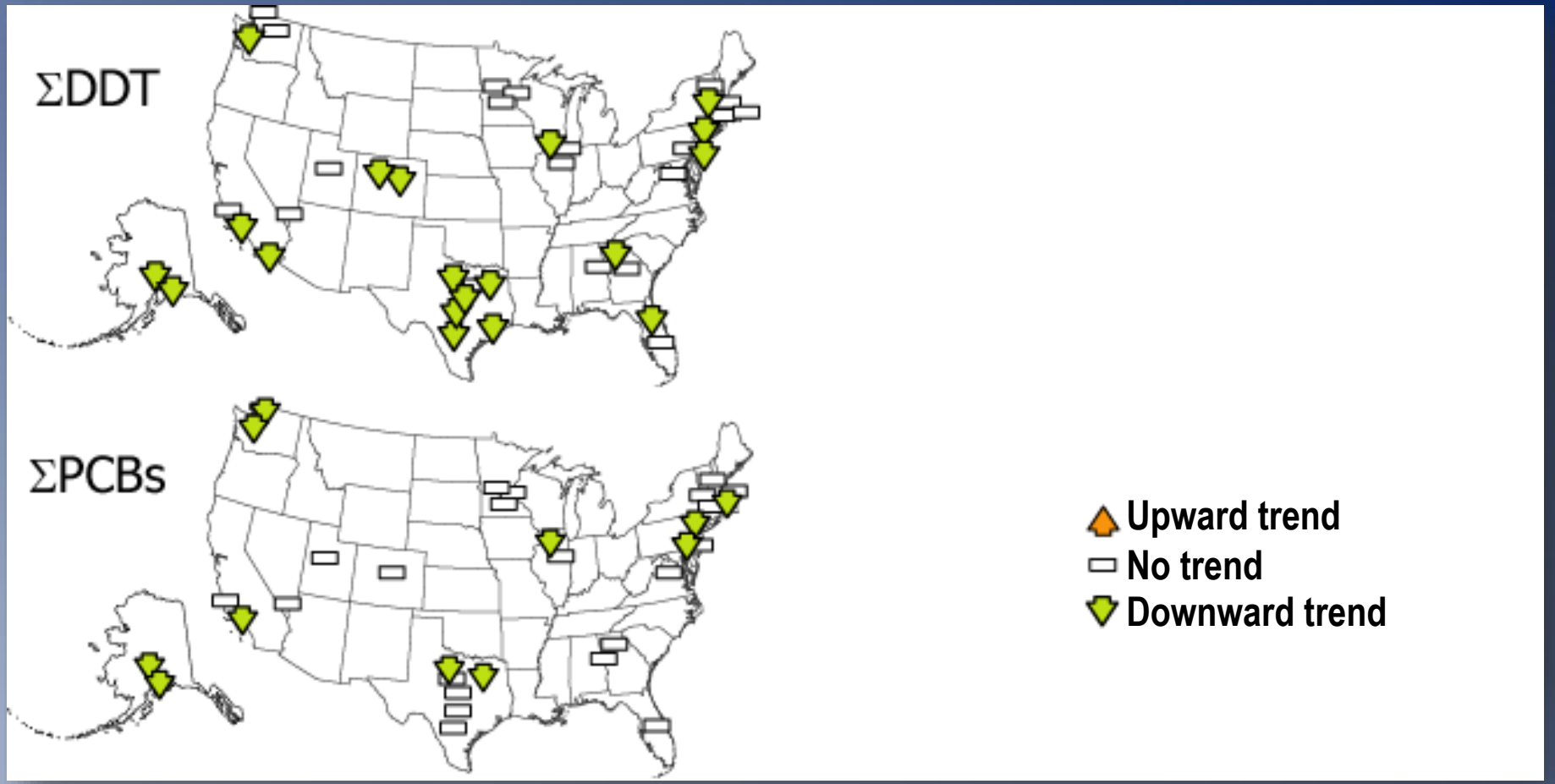
For
Texas Department of State Health Services
September 20, 2016

U.S. Department of the Interior
U.S. Geological Survey

NAWQA: Contaminant Trends in Lake Sediment

http://tx.usgs.gov/coring/index.html



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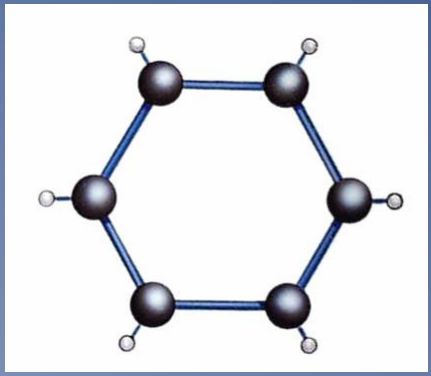
Van Metre et al., 2005, *Env. Sci. Technol.*

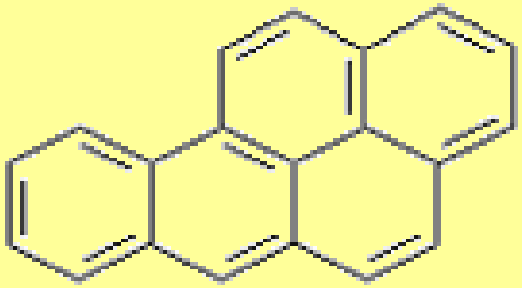
Polycyclic Aromatic Hydrocarbons (PAHs)

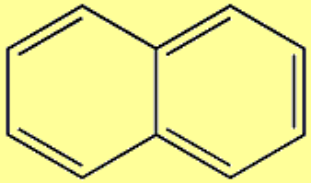


Benzene ring, building block of PAHs

Examples of PAHs

Benzo(a)pyrene

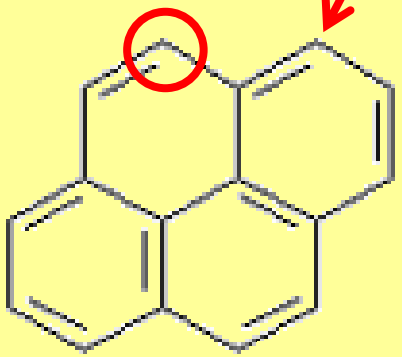




Naphthalene

=O
-OH
$-NO_2$

N, S, O



Pyrene

Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous in the urban environment

City of Austin measures high PAH in stream sediment

PAHs >1,500 mg/kg in some small drainages in residential areas

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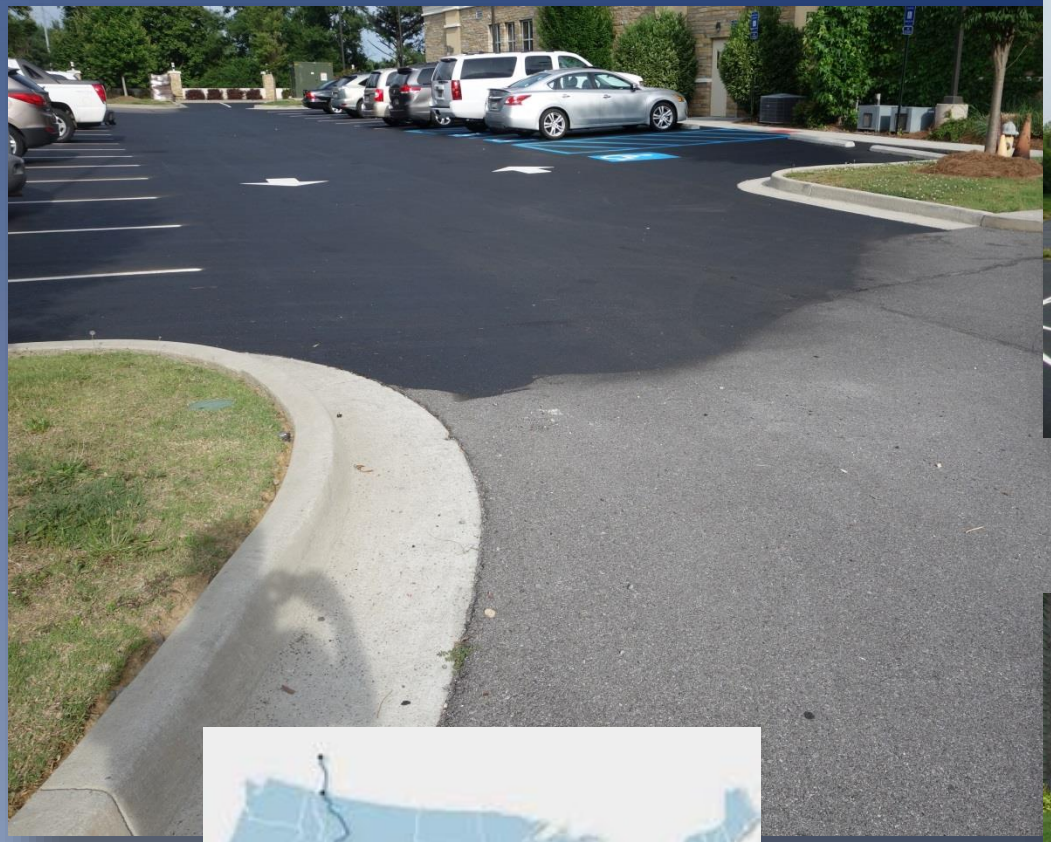

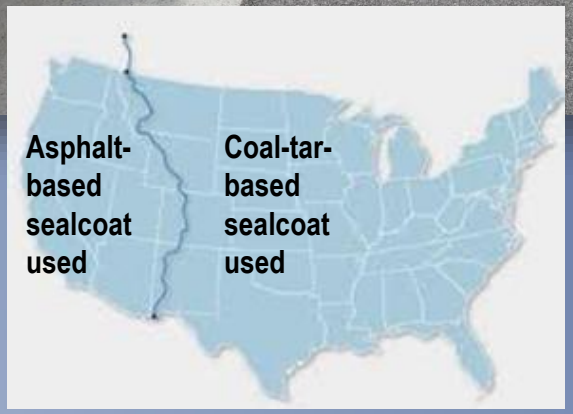

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2. COMPOSITION/ INFORMATION ON INGREDIENTS

Component	CAS NO.	% by Weight
Refined Coal Tar Pitch	65996-93-2	35 ± 5
Water	7732-18-5	50 ± 5
Hydrous Aluminum Silicate	1332-58-7	30 ± 5
Additives	Proprietary	1 ± 0.5

Note: The above components and their percentages are provided for health and safety purposes, ONLY. This document should not be construed as a guaranteed analysis of any specific lot or as specifications for the product.

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

Appearance and odor: Dark brown to black, thick consistency liquid with an aromatic odor.

WARNING STATEMENTS: Skin and eye irritant. Harmful or fatal if swallowed. Carcinogen.

POTENTIAL HEALTH EFFECTS:

Likely Routes of Exposure:

EYE CONTACT: Coal tar - volatiles and mist may cause irritation to the eyes. Eye contact with product will result in irritation, which in the absence of recommended first aid, can result in minor burns to eyes.

SKIN CONTACT: Coal tar - exposure causes skin irritation characterized by skin itching, burning, swelling, and redness. Photosensitization of the skin may occur. This irritation has a burning sensation somewhat like sunburn and is accentuated by sunlight. Repeated or prolonged contact may contribute to conditions such as dermatitis, tar warts, and rough skin.

INHALATION: Coal tar volatiles - acute effects caused from overexposure may include coughing, sneezing, and swollen or irritated nasal mucus and sinuses. Repeated and/or prolonged contact to high concentrations may result in toxic effects, such as respiratory difficulties, convulsions, and possible cardiovascular collapse may occur.

INGESTION: Coal tar - may cause gastrointestinal tract irritation followed by nausea and vomiting, abdominal discomfort, rapid pulse, etc. In extreme cases, cardiovascular collapse may occur.

Refer to Section 11 for toxicological information.

PAHs in urban sources

All concentrations in mg/kg (means of as many as 6 studies)

Fresh asphalt	1.5
Weathered asphalt	3
Fresh motor oil	4
Brake particles	16
Road dust	24
Tire particles	86
Diesel emissions	102
Gasoline emissions	370
Used motor oil	440

Pavement Sealcoat

Asphalt-based

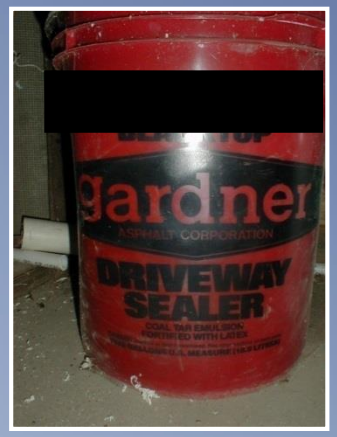
~50

Coal-tar-based

~70,000

Used motor oil

Coal-tar-based sealcoat



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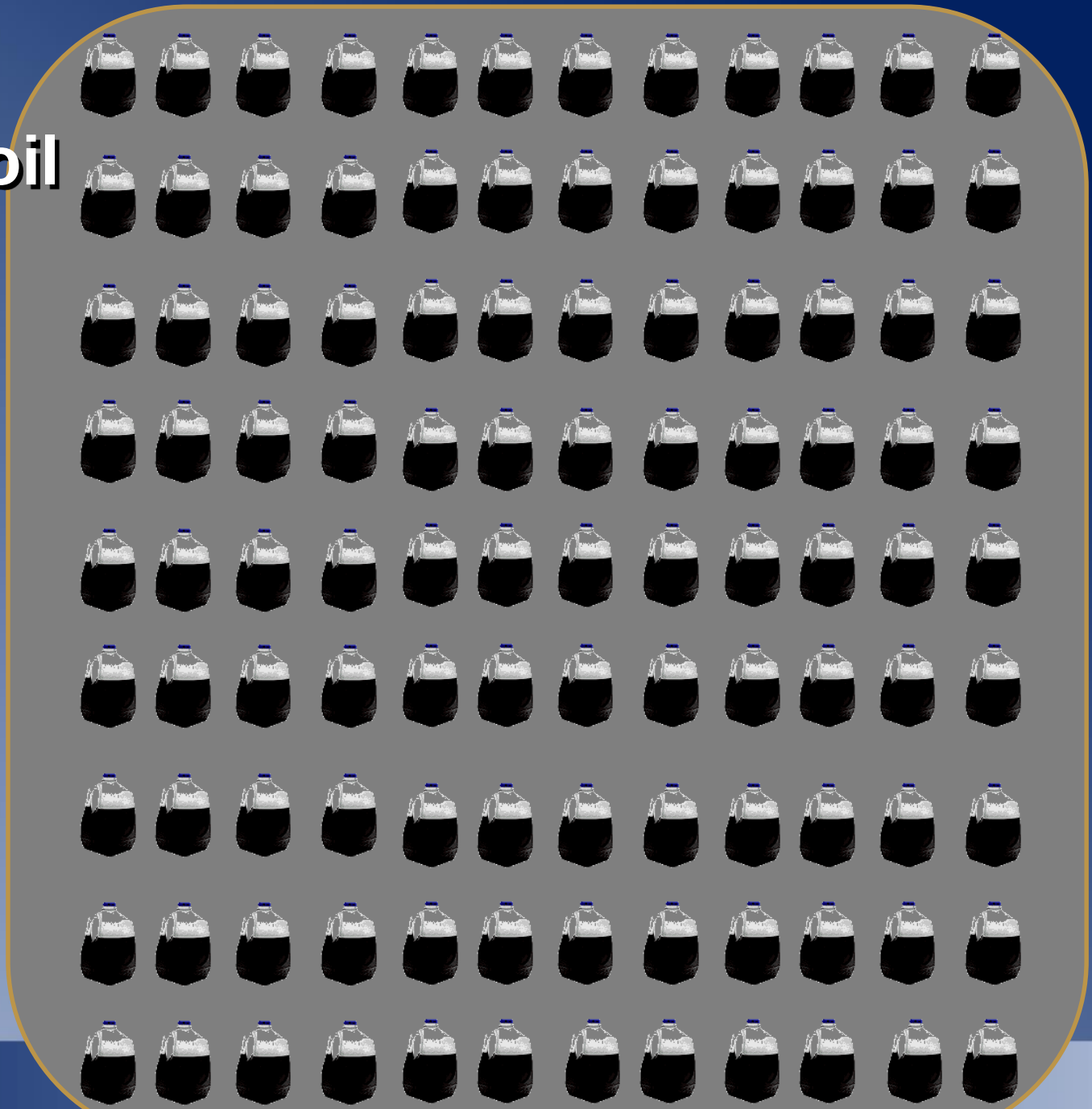

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Coal-tar-based sealcoat use

- 322 million liters (85 million gallons) per year in US (per industry)
- 440 km^2 (170 mi^2) covered in US per year

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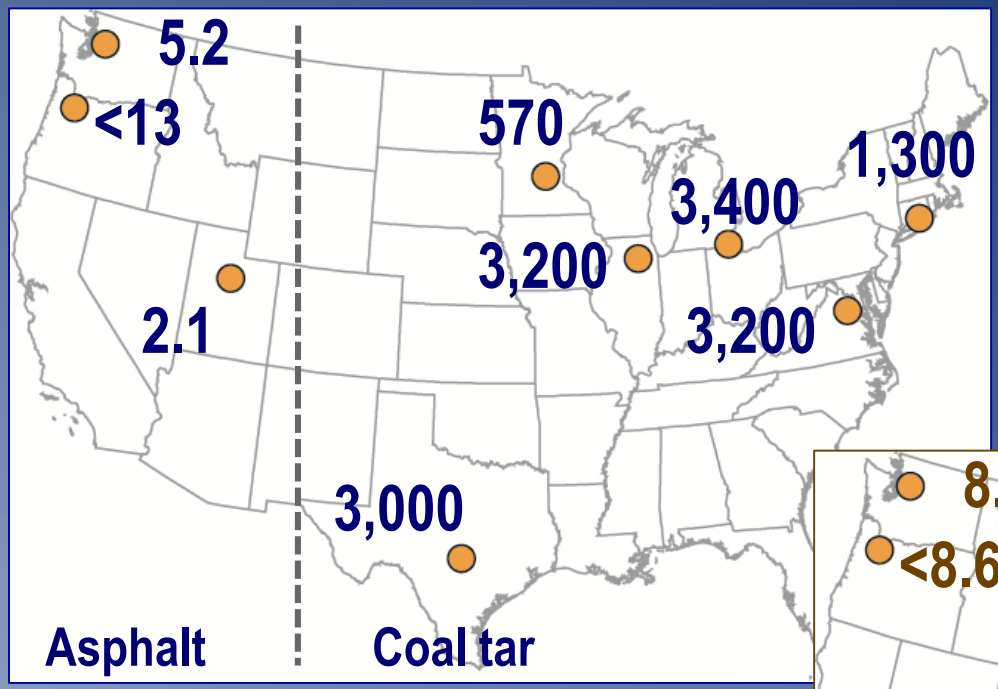
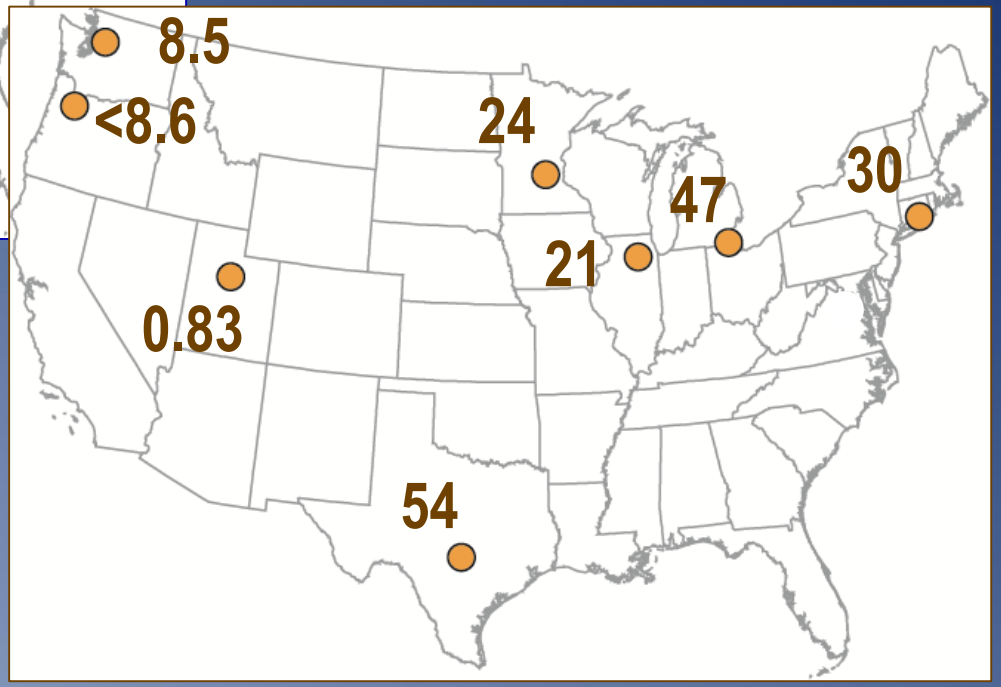
Sealed pavement dust
Total PAH (mg/kg)



Unsealed pavement dust



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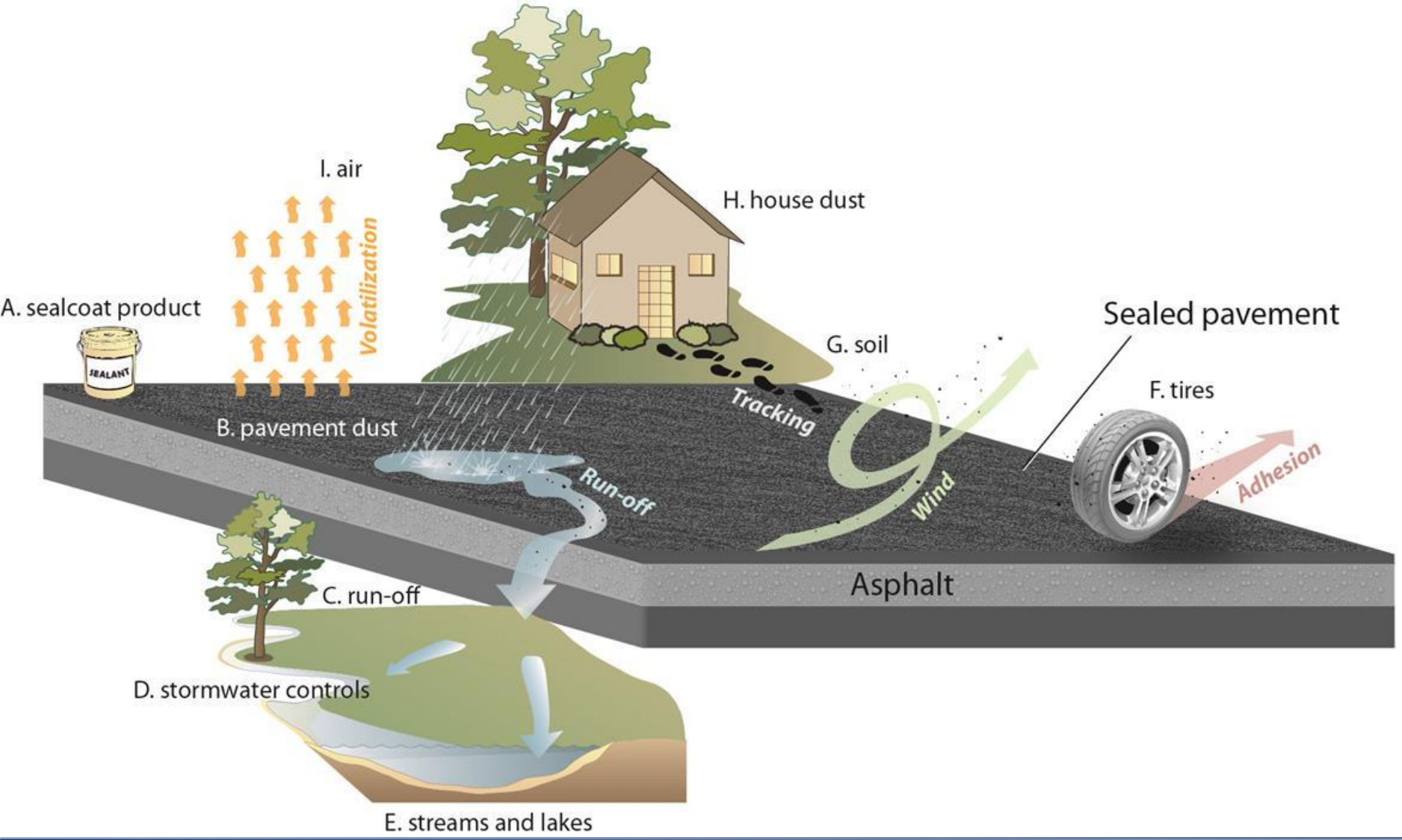
Van Metre et al., 2009, *Env. Sci. Technol.*

Sealcoat PAH transport pathways



Fish kill, 17 July 2010

Hodge's Creek, North Carolina

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https://www.youtube.com/watch?v=G5_QJIBYg5c

Sealcoat application and runoff sampling

Acute toxicity exposure protocol

USGS Columbia Environmental Research Center

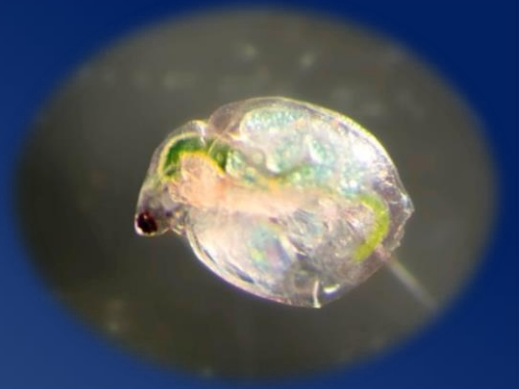
- Tested undiluted and 1:10 dilution of runoff
- 48-h exposure
- Remove surviving organisms to control water for 48-h "recovery"
- Expose half of remaining individuals to 4-h UVR to mimic sunlight

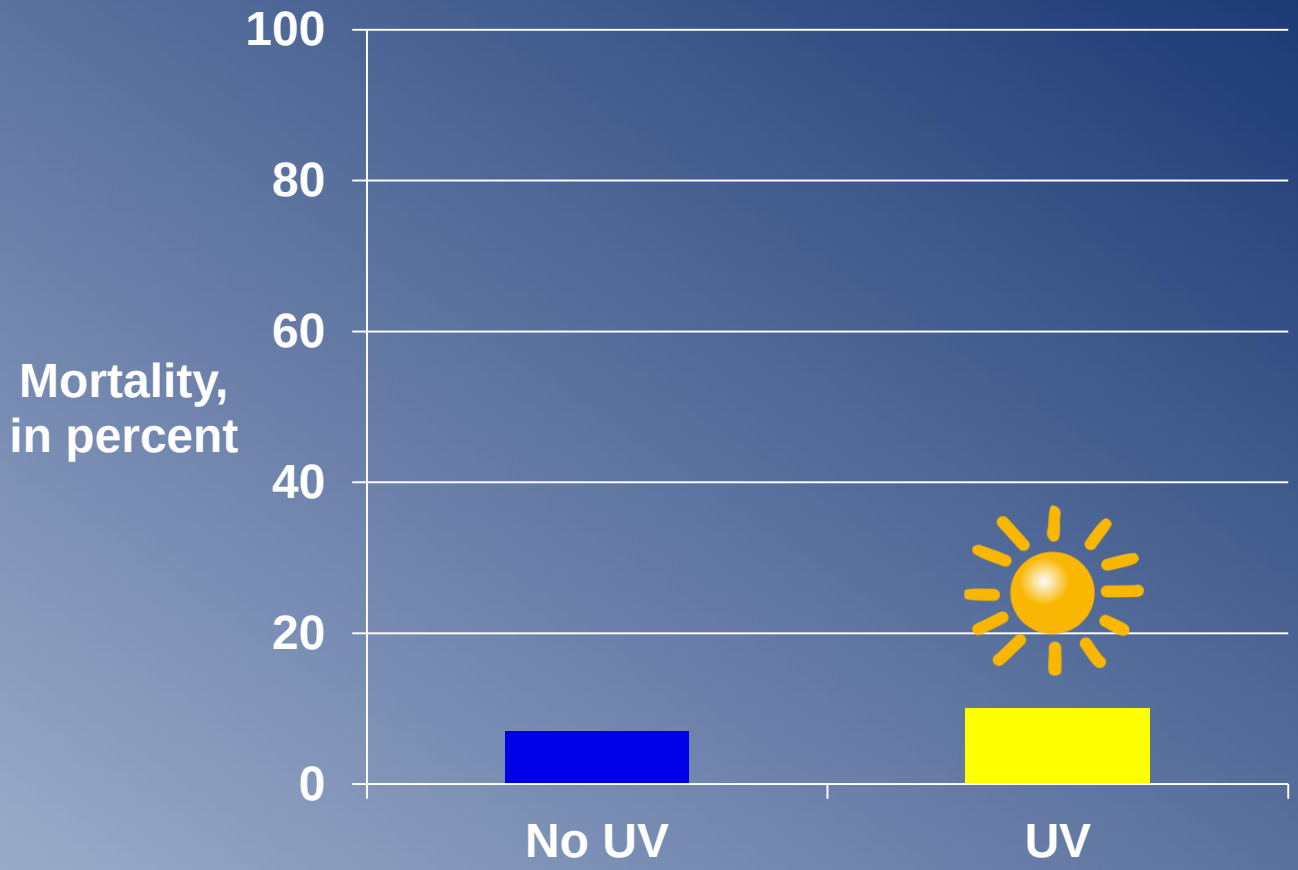
Ceriodaphnia dubia

Pimephales promelas

Mortality, *Ceriodaphnia*

Runoff from unsealed asphalt pavement





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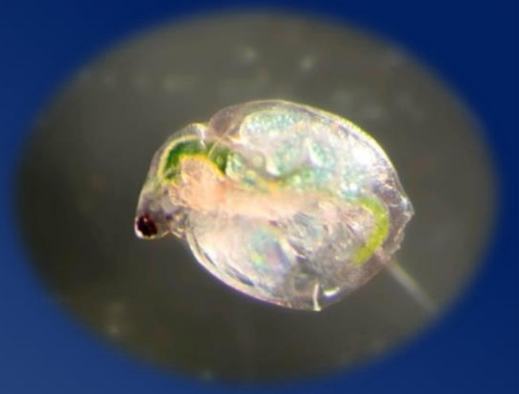
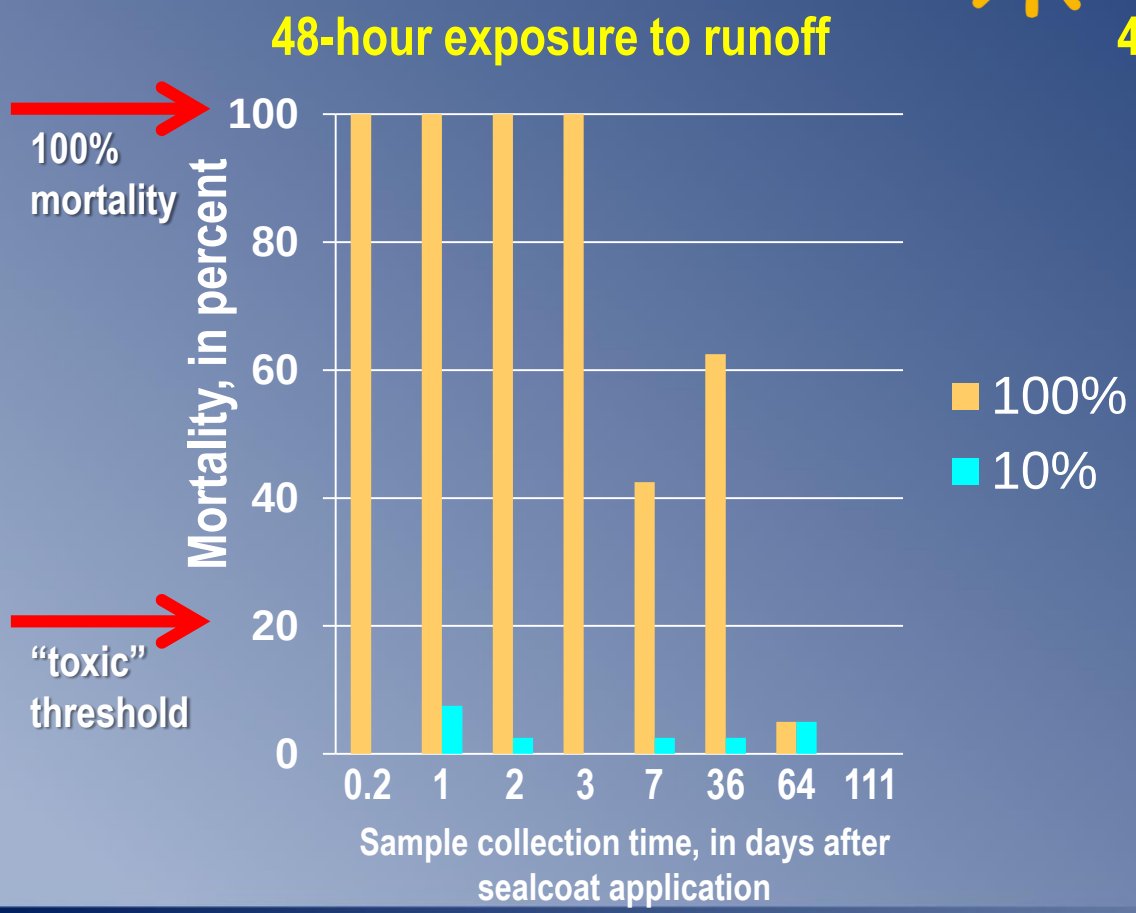
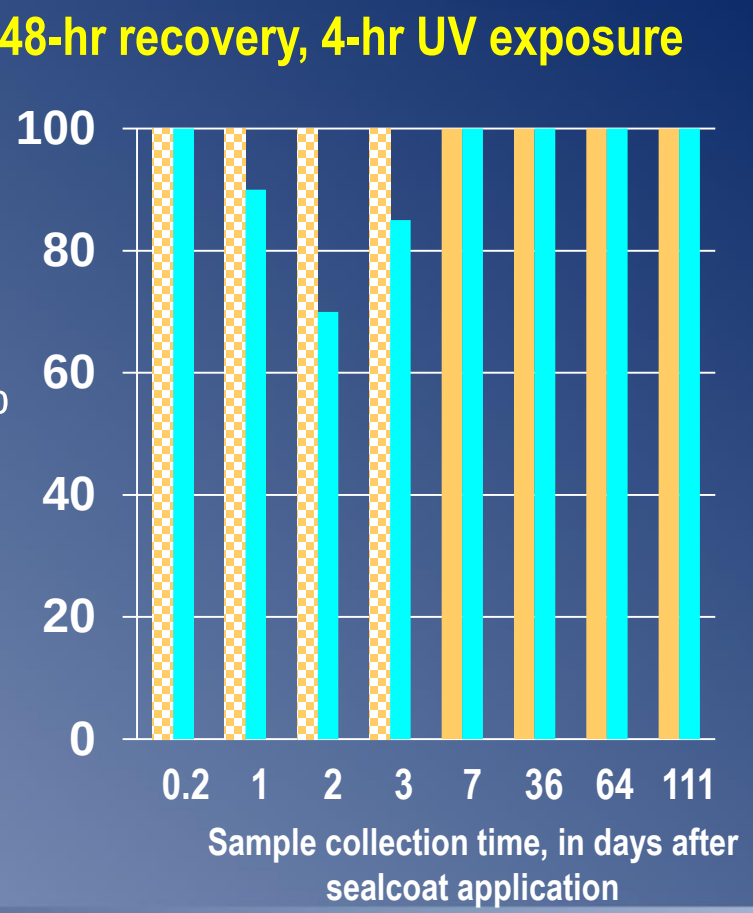
Mortality, *Ceriodaphnia*

Runoff from coal-tar-based sealcoated pavement







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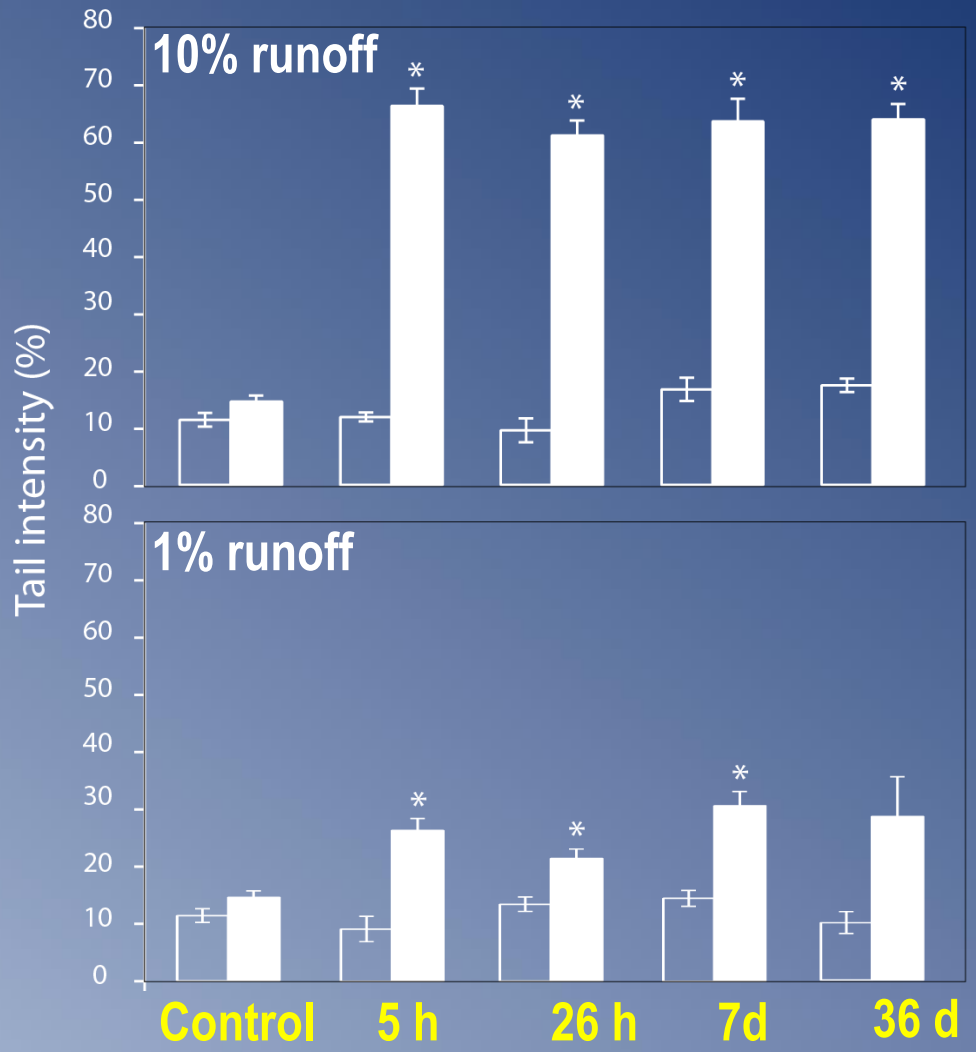
Mahler et al., 2015, *Env. Sci. Technol.*

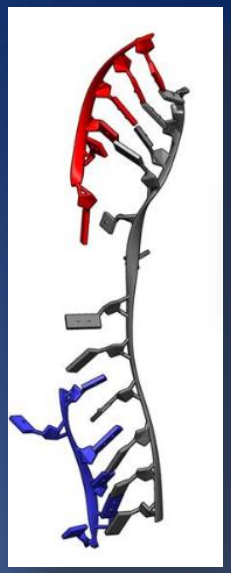

SILVERADO
R40 8511

DNA damage

More damage

Less damage





EXPLANATION

No UVA exposure

With UVA exposure

* = significantly different from control

Sample collection time

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Photos from Jupiter Images and Corbis Images, Inc.

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Austin, Tex.: 23 ground-floor apartments sampled

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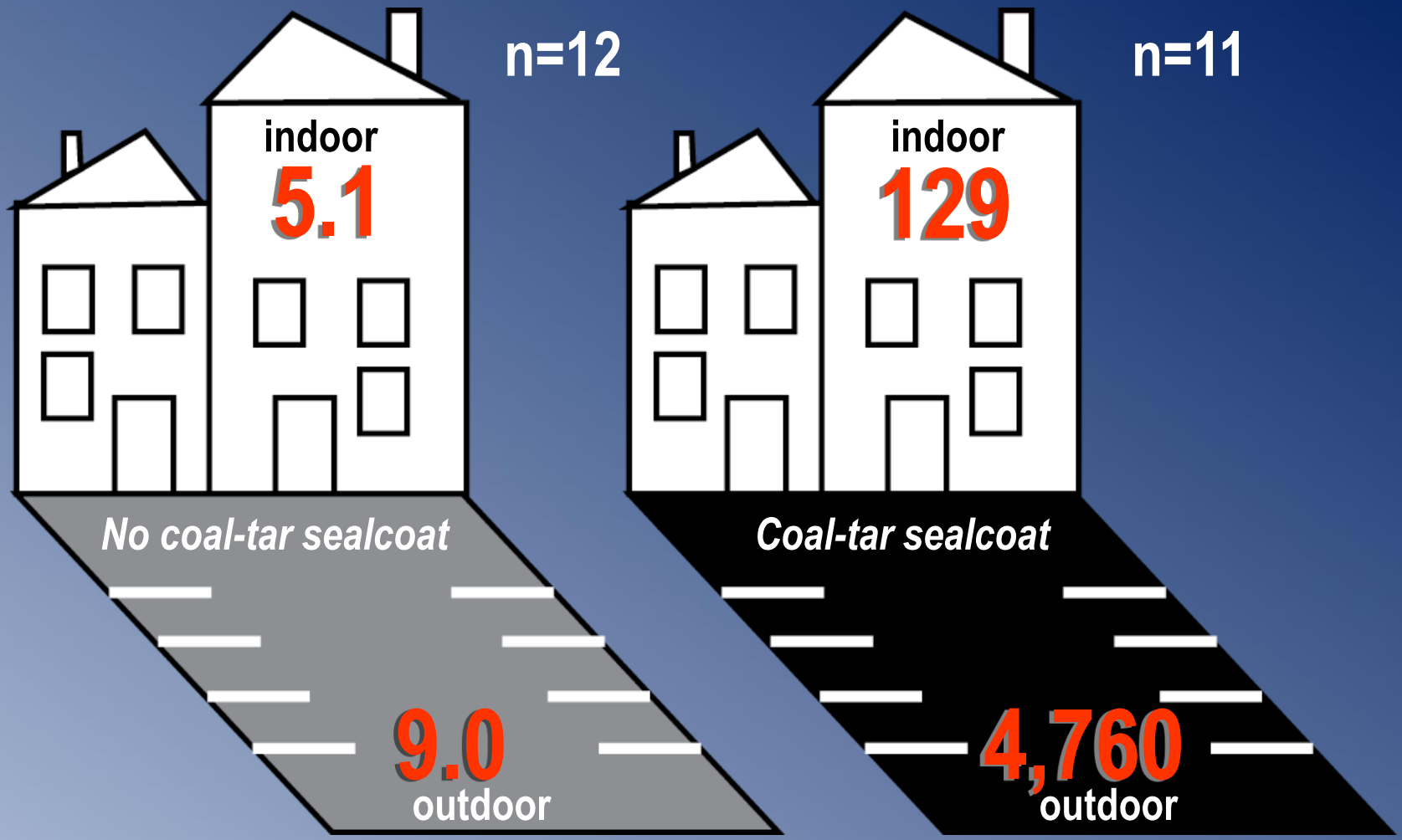
Median ΣPAH_{16} [µg/g] in indoor and parking lot dust



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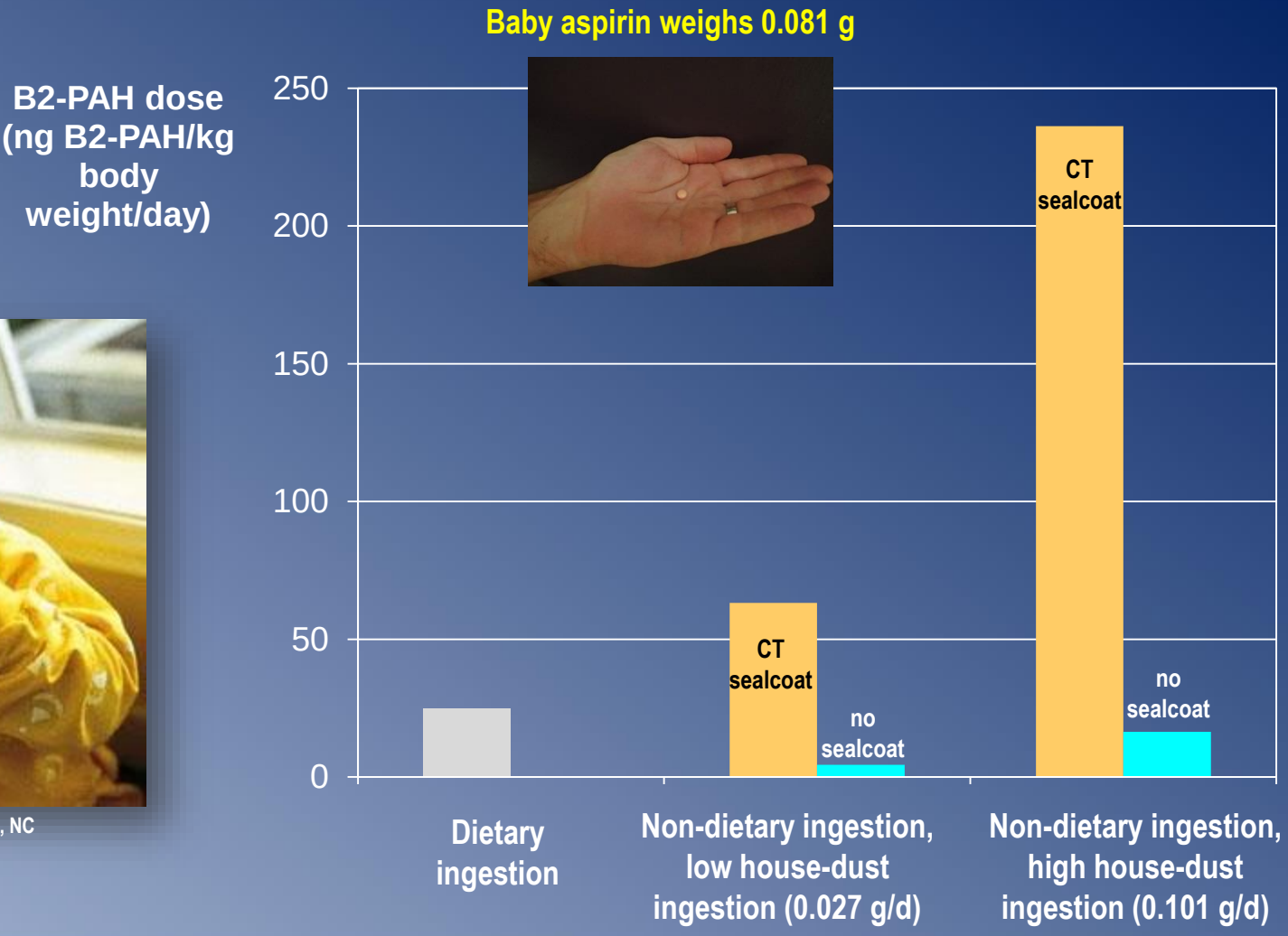
Mahler et al. , 2010, *Env. Sci. & Technol.*

Sealcoat and pre-school ingestion of PAHs

Photo courtesy of CLEARCorps Durham, NC



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Williams et al., 2012, *Environ. Poll.*

"Coal tars and coal tar pitches are known to be human carcinogens…"

National Institute of Environmental Health Sciences, USA

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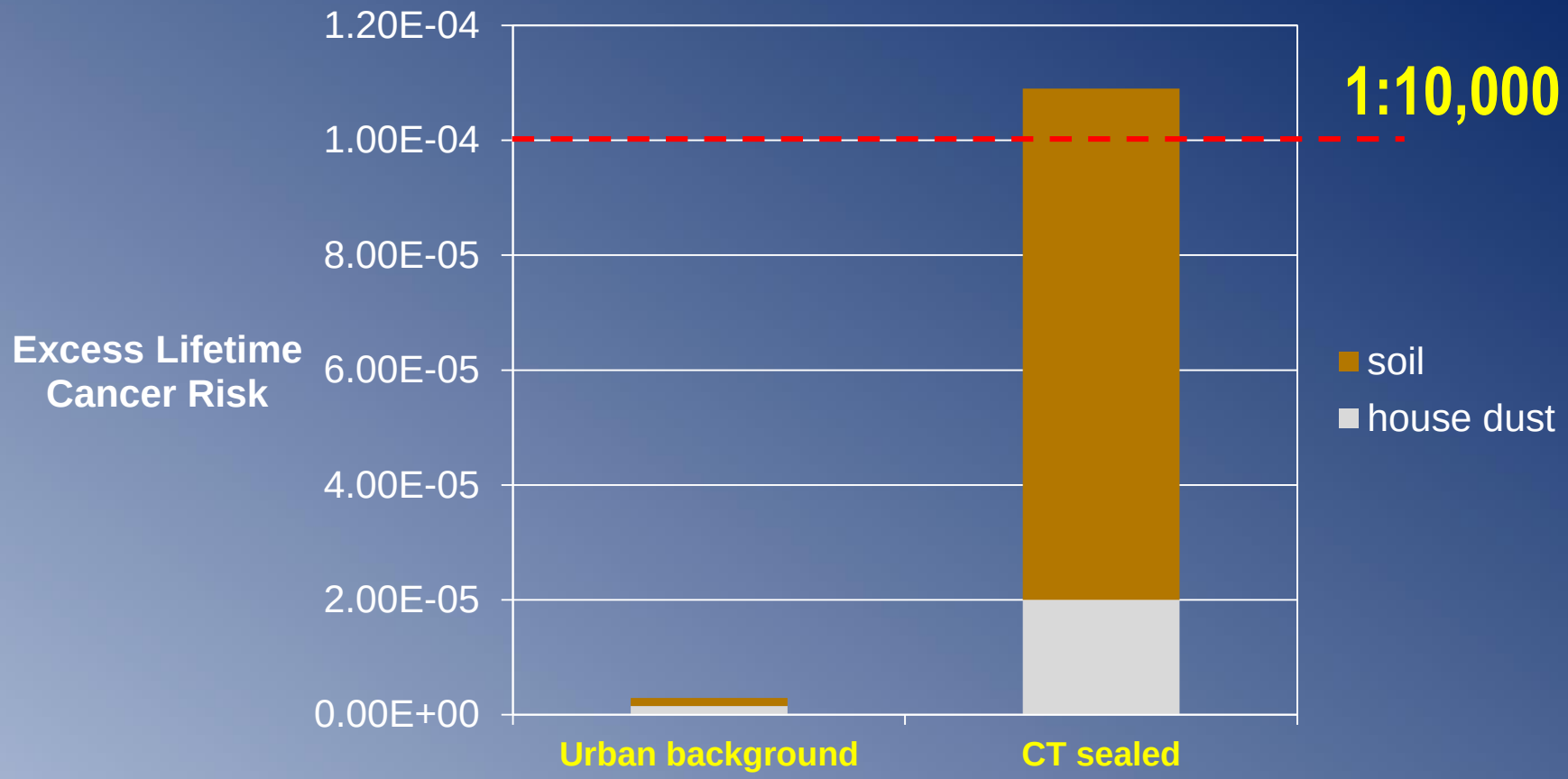
Coal-tar sealcoat contributes to a 38-fold increase in excess lifetime cancer risk (central tendency)



Williams et al., 2012, *Env. Sci. Technol.*


What are effects on air quality?

"In use" parking lots

Flux = 1.4 μg/m² h

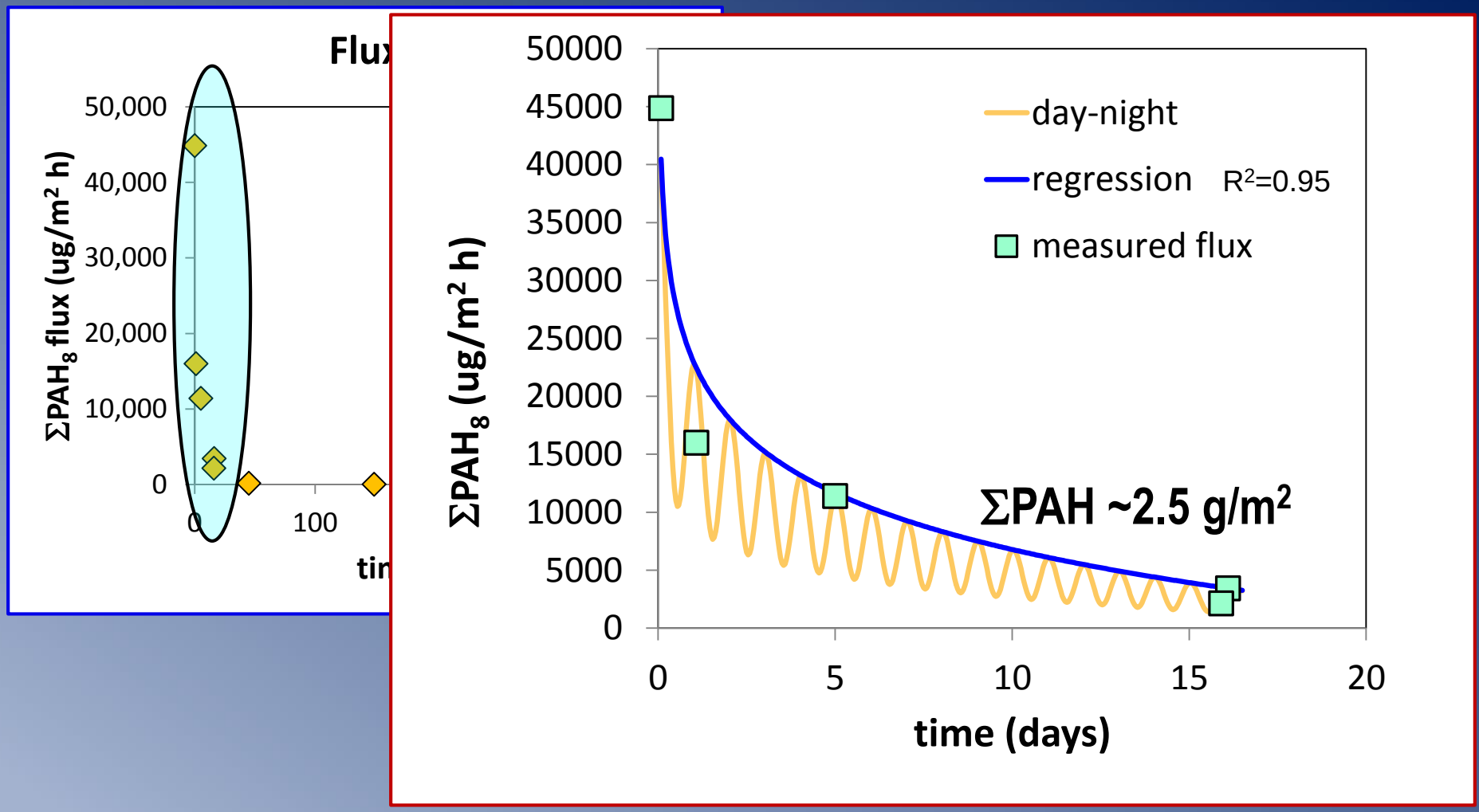
Unsealed asphalt

Flux = 88 μg/m² h

Coal-tar sealed

Van Metre et al., 2012, *Chemosphere*

Air trends after application



Van Metre et al., 2012, *Atm. Environ.*

Total PAH emissions during drying

Annual coal-tar sealcoat use	374 million L
Area covered	~440 km^2
Total PAH emitted during drying	2.5 g/m^2
ΣPAH_8 emissions/yr	**~1,000 Mg**
ΣPAH_{16} vehicle emissions, 2010	**840 Mg***

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* Shen et al., 2011, *Atmos. Environ.*

Recent studies from other institutions

- "Severe coal tar sealcoat runoff toxicity to fish is prevented by bioretention filtration" (McIntyre et al., 2015; NOAA, WSU, and FWS)
- "Identification and toxicological evaluation of unsubstituted PAHs and novel PAH derivatives in pavement sealcoat product" (Titaly et al, 2016; OSU)
- "Oral exposure to commercially available coal tar-based pavement sealcoat induces murine genetic damage and mutations" (Long et al., 2016; U Ottawa, Health Canada, King's College London)

PAHs and Coal-Tar-Based Pavement Sealcoat

http://tx.usgs.gov/sealcoat.html

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